

## One Size Doesn't Fit All

**O**n their journey through your body, medicines interact with many different molecules called proteins. Some of these proteins work to get rid of medicines, while others help medicines do their jobs. Some proteins actually “turn on” certain medicines, by switching them from an inactive form to an active one. For example, the painkiller codeine (in Tylenol#3) is a medicine that is “switched on” in this way by proteins. Your genes provide the manufacturing instructions for all of the proteins in your body. Small differences between your genes and those of your relative or neighbor can affect how you react—or don't react—to a medicine. Partly because of these genetic differences, when it comes to medicines, one size clearly does not fit all.

## What's the Payoff?

**U**ncovering differences in people's genetic make-up will help doctors prescribe the right medicine in the right amount for each person, making today's medicines more effective for everyone. The payoff will be preventing unnecessary illness and saving lives lost from the “one-size-fits-all” medicine dosing that is common today. A bonus of this type of research will be an increased understanding of the genes that cause or contribute to diseases such as cancer, heart disease, diabetes, depression, and asthma. This research will also help scientists design new strategies for making the most effective and safe future medicines.

## A Library of Knowledge

**I**n most cases, research to find normal variations in the genes for the proteins that handle medicines in the body will involve a simple test. In many cases, researchers will rub the inside of a volunteer's cheek with a cotton swab and then examine the DNA in those cheek cells. There are no health risks associated with this type of test. Some studies may involve asking people to take certain medicines. People who volunteer to do so will be fully informed of any potential risks or benefits.

After identifying the DNA in samples from study participants, scientists will store this information in a library of knowledge that will be shared by other researchers who study how people react differently to medicines. To protect participants' privacy, names and other identifying information will not be stored in this library.



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# Medicines for YOU

NATIONAL INSTITUTES OF HEALTH  
National Institute of General Medical Sciences



# DID

- According to a recent study, 2 million people were hospitalized in one year alone for reactions to properly prescribed medicines, ...and 100,000 of these people died ... making this the fourth to sixth leading cause of death in the United States.

# YOU

- A normally safe dose of a certain cancer treatment can kill a child who has an unusual gene type.
- In some people, normally effective amounts of pain relievers such as codeine offer no pain relief and can produce uncomfortable or even life-threatening side effects.
- Certain allergy medicines work well for some people but not for others.
- The National Institutes of Health is launching a research effort to understand why people can have such different reactions to medicines.

# KNOW?



### Aren't prescribed medicines already safe and effective?

For the most part, yes. But medicines are not "one-size-fits-all." While typical doses work pretty well for most people, some medicines don't work at all in certain people or the medicines can cause annoying, or even life-threatening, side effects.



### Why would a friend or relative react differently than I do to the same dose or type of medicine?

As medicines move through the body, they interact with thousands of molecules called proteins. Because each person is genetically unique, we all have tiny differences in these proteins, which can affect the way medicines do their jobs.



### Who's paying for this research?

The National Institutes of Health is providing money to scientists at universities and medical centers who come up with the best plans for carrying out research on how people respond differently to medicines.



### Why should my tax dollars be spent on medical research that is not directly related to specific diseases?

Curing and preventing disease is the National Institutes of Health's highest priority. Research on how people respond differently to medicines will make current and future treatments for diseases such as asthma, diabetes, heart disease, depression, and cancer safer and more effective. A bonus of this type of research will be a better understanding of the role many different genes play in causing or contributing to these and other diseases.



### Who will participate in this research?

National Institutes of Health-funded scientists at universities and medical centers across the country will recruit volunteers from a wide variety of groups. Research of this type relies upon studying many different people with a broad range of genetic make-ups to find the small, but normal, genetic differences among them.



### Will participating in this kind of study have any effects on my health?

Most of these research studies will involve simply rubbing the inside of a volunteer's cheek with a cotton swab. Scientists will then pull out DNA from inside the cheek cells they have collected. There are no health risks associated with this type of test.



### What will happen to my DNA sample?

Scientists will only use your DNA sample for the research that they explain to you before you agree to participate. Researchers will store the DNA information provided by your sample in a library of knowledge to be shared by scientists who do research in this field.



### Will the scientists keep my sample?

Only if you agree to this in advance. Researchers will not use or pass on your sample for other studies you don't know about.



### What about my privacy?

The privacy of all people participating in this research will be protected. Scientists will not match your name or other information that could identify you with the genetic information that is recorded in the library of knowledge.



### I heard something about "pharmacogenetics" and "pharmacogenomics" on the news—are the research studies you're talking about the same as these?

Yes. Scientists studying how genes affect the way people respond to medicines refer to this field of research as "pharmacogenetics" or "pharmacogenomics." The goal of this type of research is to tailor doses of medicines to a person's unique genetic make-up.



### How soon can I expect to benefit from this research?

The first benefits to patients could come as soon as a few years from now. From then on, the knowledge gained through this type of research is expected to help doctors tailor the medicines they prescribe to best suit each patient's individual needs.

## National Institutes of Health

The National Institutes of Health aims to improve the health of all Americans through medical research that solves mysteries about how the human body normally works—and how and why it doesn't work, when disease occurs. One goal of this research is to help improve the good effects of medicines while preventing bad reactions.

## Medicines for You

Your lifestyle, the food you eat, and where you live and work can all affect how you respond to medicines. But another key factor is your DNA, which contains your genes. Scientists are trying to figure out how the make-up of your DNA can contribute to the way you respond to medicines, including pain-killers with codeine like Tylenol<sup>®</sup>#3, antidepressants like Prozac<sup>®</sup>, and many blood pressure and asthma medicines. Scientific discoveries made through this research will provide information to guide doctors in prescribing the right amount of the right medicine for you.

